

# STANDARD OPERATING PROCEDURE FOR FISH SAMPLING INCLUDING TRAP/MINNOW NETS, SHRIMP TRAWLING, SEINING, AND ELECTROFISHING

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## Table of Contents

<b>Section</b>	<b>Subject</b>	<b>Page</b>
1.0	Scope and Application	
2.0	Summary of Method .....	5
3.0	Definitions .....	5
4.0	Health and Safety Warnings .....	6
5.0	Interferences .....	7
6.0	Personnel Qualifications.....	8
7.0	Equipment and Supplies .....	8
8.0	Sample Collection .....	14
9.0	Preparation and Deployment of Fishing Gear .....	18
10.0	Electro-fishing . .....	23
11.0	Sample Handling, Preservation, and Storage.....	27
12.0	Post Sampling Cleaning Procedure.....	35
13.0	Data and Record Management.....	35
14.0	Quality Control and Quality Assurance .....	36
15.0	Waste Management and Pollution Prevention.....	36
16.0	References.....	37

### Tables:

8.1	Number of Fish Sampling Stations Chart .....	15
10.1	Anomaly Code .....	30
10.2	Fish Vouchering .....	34

## **1. Scope & Application:**

This Standard Operating Procedure is applicable to the collection of fish using shrimp/otter trawls, trap, minnow, and seine nets, and/or electrofishing on lakes and ponds in order to obtain a representative sample of fish in the lake. These procedures can be used for community surveys, comparative studies, and impact assessments.

## **2. Summary of Method:**

Fish sampling sites are selected based on temperature and DO profiles, bathymetric information and physical habitat data of littoral habitats. Generally, between 3 and 26 fishing sites are selected depending on lake size (Figure 1). Fish are identified to species, tallied, measured and examined for external gross pathology. Fish may be retained for tissue analysis or as voucher specimens. The specific method of sampling will depend on the characteristics of the sampling location.

Seining is an “active” sampling method that only works in shallow shore areas that are one meter or less in depth and have a fairly smooth, firm substrate. Two types of seining gear can be employed: Beach seine or short seine. The short seine is used only when there are insufficient numbers of clear beach-like areas large enough to effectively use the beach seine. The beach seine is used when the site is made up of at least 50 meters of clear shoreline, so that it can be drawn up onto the shore. Alternatively, the short seine can be used when there is less than 50 meters of clear shoreline, modest amounts of vegetation, somewhat rocky bottoms, or between snags.

Trap nets and/or minnow traps are used for sampling fish in the littoral area. They are typically baited, left overnight and then retrieved the following day.

Shrimp/otter trawls are used only if the other sampling methods fail to capture a complete representation of fish species that are characteristic of mid or lower habitats. For this sampling method, a net is towed behind a boat in the pelagic and profundal zones. A 4-foot net is generally used for bottom fish in shallower locations and a 10-foot net is used in deeper areas (specific fish and water conditions determine the extent of sampling and the size of the net to be used). Upon completion of a trawling run, the net will be hauled into the boat from which it is being towed, and the fish will be deposited into holding bins.

This method of fish collection employs the use of electrical power to momentarily stun fish within an effective range from the boat shocking unit. Based primarily on ambient conductivity and the size and species of the fish being targeted for collection, a voltage is selected that will render the fish stunned, but unharmed, so they can be returned to the water. This sampling method may be used in conjunction with other fish sampling methods or alone, depending on the effectiveness of determine the representation of fish in the ecosystem

## **3. Definitions:**

- a. Pelagic: open water habitats.
- b. Littoral: shallow and near shore habitats.
- c. Anode: The positive electrode.
- d. Cathode: The negative electrode.

- e. Bonding: The permanent joining of metallic parts to form an electrically conductive path which assures electrical continuity, with the capacity to safely conduct current.
- f. Branch Circuit: The circuit conductors between the final over current device protecting the circuit and the electrical load(s).
- g. Deadman Switch: A switch that requires constant pressure to supply electrical current to the circuit.
- h. Ground: A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.
- i. Netter: The individual who nets the captured fish during electro-fishing operations.
- j. Power Control Circuit: The circuit that interconnects and adjusts the power from the pulsator or generator to the electrodes.
- k. Voltage Pulsator Electro-shocker: The device used to deliver the pulsed electric current.
- l. Floating Metal: Any metal not grounded that is a potential safety hazard.

#### **4. Health and Safety Warnings:**

- a. When working with potentially hazardous materials or situations, follow EPA, OSHA, and specific health or safety procedures.
- b. All proper personal protection clothing and equipment shall be worn. This may include rubber gloves, waders, polarized sunglasses and personal floatation devices.
- c. Follow the Boat Safety SOP when conducting sampling from a boat.
- d. Some samples may contain biological and chemical hazards. These samples should be handled with appropriate personal protective equipment.
- e. Prior to beginning each day of electrofishing, a team briefing will be held to review safety procedures and discuss potential general and site-specific hazards.
- f. A boat shock unit safety inspection and maintenance inspection will be completed each year. This does not supersede the necessity of pre-survey safety checks.
- g. A boat shock unit safety inspection will be completed prior to each day's use.
- h. All waders and gloves should be inspected prior to sampling. Any equipment found to be leaking or in poor condition should be immediately replaced or repaired before use.
- i. If gloves or boots are found to be leaking, sampling must cease until the equipment is replaced.

- j. Never touch electrodes when the boat electroshock unit is operating.
- k. At least two members of the electrofishing team should have current CPR certification and Automatic External Defibrillator (AED) training. All members of the team should be certified through the USFWS electrofishing course.
- l. No sampling will take place during heavy rain or snow.
- m. Individuals with a history of heart problems should not participate in electrofishing activities.
- n. The power supply (generator) should only be turned on immediately prior to sampling and turned off immediately after sampling and before leaving the lake.
- o. All fuel shall be transported in approved gas containers.

## **1. Interferences**

NA

## **2. Personnel Qualifications:**

- 5.1** All field samplers working at Superfund sites are required to take a 40 hour health and safety training course and a refresher course prior to engaging in any field activities.
- 5.2** Field samplers should be trained by an experienced sampler prior to initiating any procedures.
- 5.3** All personnel shall be responsible for complying with all quality assurance/quality control requirements that pertain to their organizational/technical function.
  - a. All survey crew members on the boat must have taken an EPA, US Fish and Wildlife, or similar course on electrofishing. The team leader will be considered the person operating the boat, and therefore this person must demonstrate knowledge of the principles and techniques of electrofishing. Also, the team leader must have taken a boat safety course. All electrofishing team members are required to read and be familiar with the contents of this SOP.

## **3. Equipment and Supplies:**

### **a. Net Tubs With the Following Equipment:**

- 1.0** 20 Net anchors with 0.5-m line and quick clips (3/trap net, 4ft and 10ft trawl nets, 3/spares)
- 2.0** 50 Floats with 1.5-m line and quick clips (2/trap net, 4ft and 10ft trawl nets, 1/minnow trap, 8 spares)
- 3.0** 5 Floats with 4-m line and quick clips (for trap net cod end)
- 4.0** 4ft and 10 ft trawl nets
- 5.0** 10 (per line section): Line Sections of 5-m, 10-m, 30-m (2 quick clips each)
- 6.0** Net repair twine roll

## **b. Fishing Accessories**

- . two long-handled dip nets
- a. 3 Headlamps with batteries
- b. Q-beam spotlight with pigtail adaptor
- c. 12-V battery
- d. Fish measuring boards
- e. Line section-25-m
- f. 2 Fish picks
- g. 6-7 Trap nets
- h. 8-9 Minnow traps with clips
- i. 1-2 Live nets
- j. 3-4 Five gallon buckets
- k. Beach and short seine (with poles)
- l. "Net hook" on pole
- m. 6 cases of 500 mL and 1,000 mL Museum bottles

## **c. In Cooler**

- 4 One-gallon self-sealing bags with ice
- 30-Gallon trash bag (cooler liner)
- 25 yards of foil
- 10 One-quart and one-gallon self-sealing bags
- 4 30-gall composite bag (clear or white trash bag)
- Alcohol
- Bleach (one gallon and solution sprayer)
- Anionic powdered detergent (alconox or equivalent for cleaning tissue sample equipment)

- Scrub brush for cleaning equipment
- Vermiculite or other absorbent (gal)
- Gloves for handling fish, safety glasses, electrical tape
- 1-2 boxes of self-sealing one-quart and one-gallon sized plastic bags
- Electronic data collection device

**d. Forms**

- Taxonomic keys
- Fish tissue labels with bar codes
- Sampling permit set (1/state)
- Field operations manual for lakes

**e. To Set Nets**

- Watch (24-hour setting)
- Sonar
- Sounding rod
- Trap nets (3 anchors, 2 short floats, 1 long float per site)
- Trawl nets (boat and necessary lines)
- Minnow traps (with bait if required), weight, short-line float per site
- 25-m line

**f. Seine Equipment**

- Watch (24-hour setting)
- Fish measuring board
- Q-beam with battery and pigtail adapter
- 2-3 Headlamps
- Beach and short seine



- 2-3 five gallon buckets
- Species key
- 1 Museum bottle per site (half filled with formalin)
- Measuring tape

**g. Equipment to Pull Trap Nets**

- Watch (24-hour setting)
- Fish measuring board
- 2-3 Five gallon buckets
- Species key
- 1 Museum bottle per site (half full of alcohol)
- Measuring tape
- Self-sealing plastic bag per site

**h. Electro-fishing**

- Electro-fishing boat including shocking unit with safety kill switch, anode rings, cathodes, and extra fuses.
- Elbow length rubber lineman's gloves for each team member (5,000 volt minimum rating)
- Polarized sunglasses for each team member
- Large, long-handled dip nets
- Personal floatation devices
- Holding bucket and/or holding bins (boat may be equipped with these)
- Fish measuring board
- Fish scale
- Electronic data collection device
- Portable cellular phone

- Chest and hip waders with felt soles
- Felt sole and wader repair kit
- Flagging tape
- 100 ft of nylon safety line
- Conductivity meter
- Spare parts box
- Aerator(s) with battery(s) (may be part of boat)
- Fish key
- First aid kit and AED
- Felt sole and wader repair kit
- Head nets (optional)
- Conductivity standards of 0.0001M KCL (14.9  $\mu$ mhos/cm), 0.001M KCL (147  $\mu$ mhos/cm), 0.005M KCL (735  $\mu$ mhos/cm)
- 18 megohm deionized water
- Fire extinguisher
- Cooler with ice

#### **4. Sample Collection**

##### **a. Site Selection for Fish Collection With Trap Nets/Minnow Traps and by Seining**

Fish sampling sites are selected based on the temperature and dissolved oxygen profile collected for the lake and physical habitat data from each of the physical habitat stations. The number of sampling sites is based on the size of the lake (Figure 1). One or two best professional judgment (BPJ) sites may also be selected. All sites are sampled, regardless of their expected productivity (i.e., gear is not placed to maximize catch).

Lake Area (ha)	Trap Net (with minnow trap)	Seining	Best Professional Judgment (minimum)
1-4	1	1	1
5-14	2	2	1
15-29	3	2	1
30-49	4	3	2
50-74	5	3	2
75-149	6	4	2
150-249	7	4	2
250-599	8	5	2
600-999	9	5	2
1,000 +	10	6	2

**Figure 1: Number of Fish Collection Sites (per method) as a Function of Lake Area**

**b. Selecting Trap/minnow Net Sampling Sites (littoral sampling sites)**

- i. The size of the lake dictates the number of nets to be used (Figure 1), while the decision of where to place the trap nets/minnow nets is based on the macro-habitats within the littoral zone.
- ii. There are three ways in which to choose the locations for the trap nets/minnow traps, depending on the number of littoral sampling stations and the number of major macro-habitats:

1. If the number of littoral sampling stations for a particular lake (Figure 1) is equal to the number of major macro-habitats (determined during the physical habitat assessment), randomly choose one physical habitat station to sample per major habitat

Note: A macro-habitat must extend over at least 10% of the shoreline to be considered “major”

2. If the number of littoral sampling stations (Figure 1) is greater than the number of major macro-habitats, randomly choose one physical habitat station per major macro-habitat, and assign the remaining sampling sites to physical habitat stations in the most extensive habitats in a manner that disperses the sampling evenly around the lake.

3. If the number of littoral sampling stations is less than the number of major macro-habitats, then choose to:

- a. Increase the number of littoral stations (document that this was done and why in field logbooks and or/in electronic data forms).

**Or**

- b. If possible, for some of the less extensive macro-habitats, allocate specific sampling effort to seining.

**Or**

c. Re-evaluate habitat classifications and combine similar habitats until the number of stations is equal to the number of major macro-habitats (document any revised macro-habitat classification in field notebooks and/or in the habitat assessment electronic data forms, being sure to state what changes were made and why).

**Or**

d. Randomly choose physical habitat stations in the more extensive habitats (not sampling less extensive habitats; document which habitats were sampled and why others were not sampled in field logbooks and/or in the electronic data forms).

### **c. Selecting Seining Sites**

Seining is used in shallow shore areas that are one meter or less in depth. There are two methods of seining: beach seining and short seining. Beach seine are used in sandy beach areas that are at least 50m in length. Short seine are used in areas less than 50m in length, where there is a moderate amount of vegetation, the bottom is somewhat rocky, or between snags.

Refer to the following steps to select seining sites:

While surveying the shoreline during the physical habitat assessment, note any shallow shore areas with relatively smooth, firm substrate, fairly free of snags, rocks, and other obstructions.

In the following order:

1. Give preference to sandy beaches that are at least 50m long (where the beach seine can be used). Mark two 25m segments in such locations using appropriate means (light sticks, etc.). These two segments make up one site and may be discontinuous. To be considered as one site, the two segments must be (1) within 5% of the lake shoreline length of each other and (2) within the same (contiguous) macro-habitat segment.
2. If no long beaches exist, choose beaches of shorter length for beach seining.
3. If no sites where beach seining is possible exist (or there are fewer sites than recommended for that particular lake size (Figure 1)), then choose additional sites for the short seine (can include areas with modest amounts of vegetation, somewhat rocky bottoms, or between snags). The target level of effort for the short seine is four hauls approximately 6m long in each of the two 25m lengths of shoreline. A site may include one segment which is a beach seine haul (approximately 25m long) and another segment which includes up to four short seine hauls (approximately 6m long).
4. If there are numerous possible seining locations, distribute effort among the habitats at randomly chosen physical habitat stations, at least 100 meters away from any passive gear (trap nets or minnow traps).

Note: Every reasonable effort should be made to conduct some seining. If the only seining sites are on private property, seek permission to sample from owners.

#### **d. Judgment and Extra Sampling**

Depending on the size of the lake (Figure 1), one or two extra sampling sites are to be chosen according to the sampling team's Best Professional Judgment (BPJ). Team members should decide how to add to the sampling effort to improve the overall fish collection (i.e. catch additional species and to get larger numbers of species expected to be under sampled by the standard protocol). This can be accomplished by targeting microhabitat locations by a standard method (i.e. trap net, etc.) or with a nonstandard method (i.e. daytime seining). Nonstandard methods must be approved in a permit and methods other than exclusive angling must be used.

If the number of nets to be deployed at a lake (according to figure 1) is less than the number of macro-habitats, and these habitats differ greatly, gear should be added according to standard protocols (ex. Adding trap nets so that each macro-habitat is sampled).

Document where and why extra sampling sites and BPJ sites were chosen as well as the type of gear used.

### **5. Preparation and Deployment of Fishing Gear**

#### **a. Pre-deployment Preparation**

##### **i. Trap nets**

1. For each trap net, set out four anchors, each supplied with 0.5m of line and a quick-clip.
2. Set out one float with four meters of line, quick-clip and two floats, each with 1.5m of line and quick-clip.
3. Place the anchors and floats in a carboy/tub
4. Tie the cod end of the net and lay the net on the ground, cod end down.
5. Pull the leader and each wig out and untangle them. Fold the left wing, then the right wing, neatly on top of their sides of the net. Fold the leader neatly on top of the middle of the net.
6. Load the nets onto the bow of the boat that will be used to deploy them with the cod end down, frame bottom forward, and the floats aft. Load the tubs/carboy containing the anchors and floats onto the boat.

##### **ii. Minnow Traps**

- A. Place a rock in one half of each minnow trap. When necessary, add bait.
- B. Clip the two halves of the traps closed.
- C. Attach a line (0.5m in length) tied to a float to each trap.
- D. Load minnow traps onto the boat that will be used to deploy them.

##### **iii. Shrimp/Otter Trawl**

- .1 Load the necessary nets and line onto the boat. With clips??

## **b. Deployment Methods**

### **i. Trap Nets**

Find a suitable location to set the trap nets as near as possible to each physical habitat station with:

- .1.1.1.1 A smooth, firm bottom with gentle slope,
  - .1.1.1.2 Few snags, and
  - .1.1.1.3 A depth of 2.5 meters 15 meters from shore (frame mouth location)
- 8.0 Pilot the boat to the shore. Fasten the leader on shore (or anchor to the shore).
  - 9.0 Put the motor of the boat in reverse and slowly pay out the leader, until the frame is reached.
  - 10.0 Put the motor of the boat in neutral and attach a float to both wings of the net.
  - 11.0 Throw the wings and floats into the lake.
  - 12.0 Put the motor in reverse and slowly pay out the frame of the net.
  - 13.0 Attach an anchor and float attached to the 4 meter long line to the cod end of the net.
  - 14.0 Continue to slowly move away from the shore, pulling on the cod end so that the frame is pulled erect. Drop the cod end with the attached anchor and marker float into the water. Ensure that the stretching of the trap net does not pull the leader away from the shore.
  - 15.0 For each wing of the net, retrieve the float and attach an anchor to the bottom of the net. Move each wing to a 45° with the leader.

### **ii. Minnow Traps**

1. Navigate the boat to the selected minnow trap sites.
- 2.
3. Gently lower the baited trap with attached line and float over the side of the boat and into the water.

### **iii. Night Seining With Beach Seine graphic of seine???**

1. Locate the two previously marked 25m segments.
2. After sunset, two people, holding opposite ends of the seine, proceed with one haul per designated segment as specified in the following steps:
3. Stretch the net out perpendicular to shore. Hold the shoreward stake where the water meets the beach. The seine may be shortened somewhat by rolling it onto the stakes if the bottom drops off too quickly (or if some other factor prevents the full length from being used in a safe manner).
4. Haul the seine parallel to the shore for up to 25m of shoreline or until all available space is used.

5. The offshore stake should be hauled with the bottom of the stake preceding the top.
6. Keep the lead line in contact with the lake bottom.
7. Move as rapidly as possible, keeping the seine moderately taut and, if possible, preventing the float line from becoming submerged.
8. About 2/3 of the way through the shoreline distance, the offshore person begins to rotate towards the shore, aiming for the segment end marker. Meanwhile, the shoreward person slows down, such that both people meet (about 3m apart) on shore at the end of the segment.
9. Pull both ends of the net onto the shore. While performing this step:
  10. Keep the lead line in contact with the bottom.
  11. Don't pull too fast; otherwise fish may jump over the float line.
  12. The lead line should be slightly forward of the float line.
  13. Pull the "pocket" of the net onto the shore, making sure to:
    14. Keep the floats high.
    15. Keep the lead line taut and on the bottom until the net is out of the water.
  16. Shake fish caught in the wings towards the center of the net.
17. Once fish are landed (after each haul):
  18. Remove all fish from the net and place them into live wells.
19. Calculate the area seined by multiplying the working length of the net by the estimated distance seined. Sum the total for the gear at the station and record this and other sampling information in field logbooks and/or in electronic data forms. Process all of the fish that have been collected.

#### iv. Night seining with the short seine

- 9.3 Locate the pre-marked sampling segments.
- 9.3 After sunset, two people (holding opposite ends of the seine) proceed to make up to four passes per designated segment as follows:
  - 9.3 Stretch the net out perpendicular to shore. Hold the shoreward stake where the water meets the beach. The seine may be shortened somewhat by rolling it onto the stakes if the bottom drops off too quickly (or if some other factor prevents the full length from being used in a safe manner).
- 9.3 Moving rapidly, haul the seine for several meters in any direction (the direction is dependent on the site conditions, If possible, haul the seine towards the shore).

9.3 Keep the lead line in contact with the bottom, making sure that the float line does not get submerged.

9.3 The bottom of the stake should precede the top. Once the desired area has been traversed, while still moving, quickly pull both ends of the lead line forward and out of the water, keeping the float line up out of the water. Keep a pocket in the middle of the net for holding fish while moving to shore.

9.3 Once fish are landed (following each haul):

9.3 Remove all fish from the net and place them into live wells.

9.3 Calculate the area seined by multiplying the working length of the net by the estimated distance seined. Sum the total for the gear. Record this and other sampling information in field logbooks and/or in electronic data forms.

9.3 Process all of the fish that have been collected.

#### **v. Shrimp/Otter Trawl**

1. Navigate the sampling vessel to the area in the profundal or pelagic zone where trawling is to take place.
2. While moving the boat at an appropriate speed, slowly pay out the net (either the four foot net or 10 foot net) until it is set in the water column at the desired depth (this will depend on the target fish species (bottom vs. mid-level species). The depth of the net can be controlled by changing the boat speed and the deployment distance from the boat.
3. Tow the net for the desired distance or time.
4. Upon completion of a trawling run, haul the net into the boat and deposit fish in holding bins.
5. Process fish that have been collected.

#### **6. Electrofishing- Boat electrofishing unit and team member preparation**

1. Determine the conductivity of the water body to be sampled
2. Reference the required sampling time (power on) per lake from the **sampling plan** and zero the time on the boat with the magnet.
3. Each member of the team entering the boat is to wear rubber chest waders with felt soles, elbow length rubber gloves, a pair of polarized sunglasses and a floatation device.
4. Individuals netting fish will be equipped with a long-handled dip net corresponding to the size of fish expected to be caught and the complexity of habitat to be fished.
5. If a fourth individual is present they shall identify fish as they are placed in the holding bins and monitor the fish for signs of stress. Stressed fish are evidenced by “foam” in the holding bin, fish rising to the water surface, or an inability of the fish to remain upright. Special



attention and care are needed when dealing with cold-water species (i.e. salmon, trout, sculpins).

6. Prior to sampling the following checklist should be run through to ensure that the boat is safe and ready for sampling. (Note, consult the boat SOP for more details on boat safety and preparation.)
7. Place the anode array on the boom and extend the boom to the desired position. The boom can be moved up and down or left and right depending on the sampling conditions.
8. Check all electrical connections, batteries, and motor.
9. Check for floating metal
10. Start generator (key start, but make sure the circuit breaker is off) Place the duty and pulse settings to their lowest positions).
11. Select AC, DC, or Pulsed DC (Depending on conditions)
12. Select pulse rate (only change when duty setting is in the lowest position)
13. Turn on power switch.
14. Check the overload indicator light. If the light goes on and a rapid beep occurs when the dead man switch is engaged, reduce the voltage selector until the light no longer turns on.  
**Remember never to change the voltage while the foot switch is engaged).** If the overload continues, return to the boat shocker to the manufacturer for service.
15. Select amps: 3-6 amps
16. Make sure shocking time has been zeroed out
17. Select the desired voltage from the voltage range switch. Effective range for sampling is based on conductivity and prior sampling experience. In general, 100-400V for water >300  $\mu\text{mhos/cm}$ , 700-800V for 100- 300  $\mu\text{mhos/cm}$  and 900-1100V for water <100  $\mu\text{mhos/cm}$ .
18. Select the desired waveform.

**Note: Use the lowest effective voltage and keep in mind that larger fish are sensitive to (2-3 times) lower voltages. Consequently, low voltages and lower frequencies are most effective for sampling larger fish**

19. Check to see the response on the fish. Adjust voltage accordingly.  
**Warning: Never adjust the voltage when the foot switch is activated.**
20. If the unit overloads, a rapid beep will be heard, the overload indicator light will turn on and the output will be disabled. If the electrofishing unit is overloaded, disengaging the dead man switch can reset the unit. If the enerator is overloaded, the unit must be shut down and restarted. In either case a lower voltage selection should be made.

21. The fish holding bins should be filled when the boat enters the water prior to sampling so that as soon as fish are captured they can be immediately placed in the bins to reduce stress. The aerator should be tested prior to sampling.

#### **a. Electrofishing – Sample collection**

1. Fish sampling proceeds around the lake. The boat operator will maneuver the boat around the lake, shocking in habitats likely to contain the target fish species. Notations are made for the number and species of fish caught in each habitat or as otherwise specified in the Quality Assurance Project Plan (QAPP). Netters proceed at the same pace as the boat, and should always be in communication with the team leader to inform them of how fast and in what direction the boat should move. Each netter collects stunned fish on their side of the boat. Netters should not allow the poles of the nets to cross over the opposite side of the railing in an effort to collect fish. Netters will also stay inside the radius of the anode pole to remain clear of the voltage source. If an individual begins to fall, he or she shall loudly shout the word “down”, alerting the boat operator or other netter to release the dead man switch. If a fall has taken place and protective gear has become wet inside, the sampling is temporarily suspended and a replacement person or equipment is put in place or sampling is resumed once the equipment has become dry.
2. Individuals netting fish identify the number and type of each fish species caught. (The fourth person in the boat may also serve to identify and record all species.) Observations or notations are verbally relayed to the individual manning the holding tanks and all information is recorded in a logbook or other recording device.
3. Caught fish will be transferred to the person in charge of the holding tank. This individual will monitor the health of the fish and make transfers to other holding tanks if they appear stressed or overcrowded.
4. At the completion of the sampling run, total shock time for the lake will be recorded.
5. After completing the sampling, turn off equipment by switching the generator to the off position and turning off the master switch.
6. Upon survey completion, some fish will be released and returned to the water body with the exception of any unknown species being held for further identification or disposition.
7. Night fishing sampling events need further planning to ensure safety. Night sampling is more difficult due to limited visibility. It is helpful to survey sampling areas during the day and place reflective buoys in sampling locations to mark the sampling site. It is also suggested that possible obstructions be noted during the day as they can act as potential hazards during night sampling. All boat lights are to be checked to make sure they emit enough light and are angled in the proper positions. Netters need to pay particular attention to the sampling area to alert the boat operator of potential hazards.

#### **b. Retrieval methods for trap nets, minnow traps and shrimp/otter trawl nets**

Team members retrieve one piece of gear at a time, and process the fish in that gear before proceeding to the next gear site. Minnow traps are retrieved while retrieving adjacent gear, but fish are kept in separate buckets.

##### **i. Trap Nets and Minnow Traps**

1. Trap nets are retrieved starting with the leader, which acts to chase fish into the net, reducing the chances of losing fish during the retrieval process.

##### **ii. Trap Nets:**

- Remove the anchor from each wing.

- Slowly move the boat towards the leader attached to the shore. Unfasten the leader from where its attachment site.
- Put the engine in neutral. Pull the leader, frame, then the cod end into the boat, all while shaking the fish down into the cod end. Detach the anchor and float from the cod end.
- Untie the cod end and empty the contents of the net into live wells. Recheck frame box and other net parts for remaining fish.
- Pull the wings aboard the boat and detach the floats.
- From the “net settings” tab in the electronic data form, record the net type, collection start date and time and collection end date and time
- Go on to process fish.

### iii. Minnow Trap

1. Pull the minnow trap before leaving stations where trap nets are located.
2. Fish can either be processed directly as they are removed from the trap or placed into a live well (separate from the one used for the trap net) for later processing.
3. From the “net settings” tab in the electronic data form, record the net type, collection start date and time and collection end date and time.

### iv. Shrimp/Otter Trawl

1. Haul the net into the boat, making sure not to loose any fish. Deposit fish in holding bins for processing.

### c. Sample Processing

1. Most of the fish processing tasks are completed at each station before moving on to the next. Depending on lake size, weather conditions, and numbers of fish collected, the process may be done either in the boat or at the landing. **Processing of specimens that are to be analyzed for tissue contaminants is done once per lake (at the landing).**
2. At each sampling site, fish processing involves the following general tasks:

#### i. For each fish:

1. Identify individual fish to species place in a general age class (unknown, adult, juvenile, or young-of-year (YOY)).
2. Examine for external anomalies (deformities, lesions, tumors, eroded fins). Examine body surfaces, fins, and gills. Look for any discoloration of body surfaces (e.g., darkening hemorrhaging, cloudiness), white spots, raised scales, parasites, lumps, growths, ulcerations, fin erosion, deformities of the vertebral column and mandibles, swelling of the anus, short operculum, missingfins, or any other abnormality). Note the extent of any abnormalities

To enter this information on the electronic data forms:

3. Select the “Fish Collection” data form
4. Select the fish species from the “Select fish” pull-down menu
5. Select the age class of the fish from the “Age” pull-down menu
6. From the “Method” pull-down menu, select the collection method
7. Select applicable extent of external abnormalities from the “Deformities Lesions, Eroded fins, and/or Tumors” pull-down menus. The choices are none, low, moderate or high

**ii. For each species:**

1. Measure the total lengths (in cm) of **up to 20 individuals** of each long-lived species using the fish measuring board (measure total length-mouth closed and caudal fin compressed to achieve maximum length).
2. If there are 20 or fewer individuals present, measure all of the fish.
3. If there are more than 20 individuals present, first separate any obvious outliers (fish noticeably larger or smaller than the majority). Generally, outliers are those individuals at least 30 percent larger or smaller than the largest or smallest representative of the nonoutliers.
4. After separating the outliers, measure a random subsample (about 20) of the remaining specimens
5. Tally-count each species by general age group (adult, juvenile, or young-of- year). This a judgement based on size, color, and overall appearance. The purpose for this information is to provide at least qualitative evidence as to whether or not a species is reproducing in a lake.
6. Tally-count each species using the electronic data forms: Select the “Fish Tally” tab on the electronic data form
  - a. Select the fish species (common name) from the “Fish” pull-down menu
  - b. Select the number of fish counted from the “Multiply” pull-down menu
  - c. Select “Add” to enter the information
7. Be on the look-out for any hybrid and newly introduced species. Retain any unknown species as museum vouchers
8. **preserve example specimens** of each species (as well as any unknown species) as museum vouchers
9. Set aside the best five specimens of one species that is highly likely of being caught and eaten by predators (human or wildlife) and of containing detectable levels of toxic substances. These specimens will have their tissue analyzed for the presence of contaminants (see 8.5.3)

**iii. Selection of fish for tissue contaminant analysis**

1. Determine from among the candidates (in the live well or on ice) which species have individuals that meet as many of the selection criteria for tissue analysis as possible. Follow the guidelines in to select the final sample (below). As a precaution, do not return the non-selected fish to the lake until all sample processing is complete. Note that the term "candidate" does not refer to just the final sample. Candidates are the entire catch (excluding individuals that are too small for consideration) of individuals of that species from which the final sample is chosen.
2. Select 3 to 5 individuals of the highest priority species (species having a high likelihood of being caught and eaten by predators (human or wildlife)) available that are at or above the preferred minimum length for that species. When possible, the individuals should be of similar size, collected from various areas of the lake, and relatively fresh. Collecting 5 fish is generally a higher priority than getting species higher on the target species list. For example, if 3 of the top priority species and 10 of the third priority species (all of the preferred size) are caught, use the best 5-fish sample of the third priority species.

Note: If the size discrepancy is large (but the species priority rank is the same), choose in favor of 3 or 4 large versus 5 small fish. For example, if there are 3 of species "A" at 400 mm total length and 5 of species "B" at 150 mm total length, select species "A".

Ideally, individuals should be as large as possible and all of the same size. The guideline is that the length of the smallest fish in the 3-to-5 fish sample be at least 75% of the largest. This size relationship can be estimated visually. This is a goal and not a requirement. Collecting high priority target species at or above the preferred minimum length is more important than meeting this similar size goal.

3. Select live and freshly dead fish preferentially. However, fish selected do not have to be alive.
4. Decision criteria for some cases where the sample choice may not be clear:
5. If two predator species have been collected, one species with 3 or 4 individuals (> preferred minimum size) and one species with 5 individuals (> preferred minimum size), choose the 5-fish sample even if this species is of lower priority, unless the 5 fish are much smaller than the 3 to 4 individuals of the higher ranking species.
6. If 1 to 4 individuals at or above the preferred minimum length of any target species are collected, add smaller individuals of the same species to bring the total to 5.
7. If fewer than 5 individuals of any size of any target species are collected, use a smaller number. In this case, also send 5 individuals of a non-target species or 20 to 60 small fish (minnows or other) if available (resulting in two separate samples).
8. If neither (b) nor (c) above works, use 20 to 60 (preferred number if available) small fish (minnows or other), all of one species if possible. The intent is to obtain a fish tissue sample of some kind from each lake.
9. Release all remaining fish that are alive.

#### **iv. Processing of fish to be analyzed for tissue contaminants**

1. Keep work surfaces and wrapping materials clean and free of potential contaminants (such as sunscreen, insect repellent, perfumes, etc.).

2. Measure total length of individuals selected. If a scale is provided, obtain a weight for the entire sample, either by weighing all individuals at once or by summing weights obtained for individual fish.
3. Wrap each fish in aluminum foil (unless there are many small fish) with the dull side of the foil against the fish. Place all the wrapped fish in a self-sealing 1-gal plastic bag or in a 30-gal plastic bag.
4. Expel excess air and seal the bag. Wrap tape around the bag neck to seal it provide a surface to which the sample label can be attached.
5. Place labeled self-sealing 1-gal plastic or 30-gal plastic bags containing the sample into a second plastic bag and seal it. Place ice in self-sealing plastic or 30-gal plastic bags (to keep ice and water away from the fish sample). Fold over the bag neck and seal with tape. Place bagged ice in a cooler with the double-bagged fish sample.
6. Ship fish as soon as possible after collection, using overnight air courier.
7. After all fish species have been processed, select a five-fish composite sample from among the tissue contaminant candidates and process for shipping. The composite sample consists of whole fish. The general criteria (in order) for selecting individuals for the composite sample are:
  - a. Five individuals of one species
  - b. A species high on the food chain
  - c. Large fish
  - d. Fish that are approximately the same size
  - e. Fish collected from all areas of the lake
  - f. Live or freshly dead fish
8. If there are no top predators, insufficient numbers of them, or they are relatively small, then the selection priority becomes (in order):
  1. Smaller primary predators
  2. Bottom feeders
  3. Any species caught in sufficient numbers so as to make up a sample.

## **7. Voucher Specimens**

1. Voucher specimens of all species are collected as part of the quality assurance (QA) program, and to provide for historical documentation. Exceptions are to be made for large individuals of easy to identify species, which should be photographically documented. Retain larger numbers (if not all) of small or difficult to identify species as well as suspected hybrids.
2. Where very large numbers of small or difficult to identify species are collected, sort all individual fishes to the lowest taxonomic level (with which you are comfortable), and count and preserve a generous random sub-sample (or all) of each taxa.

3. Preserve voucher specimens in alcohol [?]
4. Take care when handling fish so that they stay in the best condition as possible. Preserve specimens soon after collection when possible. Specimens should not be bent nor crowded in the sample containers. Avoid selecting long-dead individuals or those badly damaged in the nets, if possible. For specimens >6 inches (about 150 mm), make a small slit on the right side to flood the body cavity with preservative.
5. If any "species of concern" are collected live, quickly photograph and release them. If they are dead, they should be preserved as vouchers in alcohol. It is important to notify the appropriate state officials in either case. The field crews are encouraged to preserve examples of amphibians, crayfish, leeches, or mollusks taken in the traps or otherwise collected, as well as examples of fish with anomalies or parasites. For these non-fish organisms, use one or two self-sealing plastic bags per lake and keep them separate from the fish vouchers (crayfish can do considerable damage to fish vouchers). Leeches should be anesthetized in Alka-Seltzer water before being placed in alcohol (they form tight balls otherwise).
6. The process for selecting samples for vouchering is as follows:

**Group I** - Easy to identify as adults, usually large, of less interest to museums.

**Adults**--Preserve 1 or 2 specimens per lake only if small (<200 mm total length) and space permits. Document others with a photograph.

**Juvenile**--Preserve 1 or 2 specimens for each gear type at each station.

**Young of Year (YOY)**--Preserve 1 to 5 specimens for each gear type at each station.

**Group II** - Adults may be tricky to identify OR species uncommon in the region, but size is an issue (due to preservation and/or shipping constraints).

**Adults**--Preserve 1 or 2 specimens of small adults from each gear type (<200 mm). If only large adults, preserve 1 or 2 specimens per lake and document with a digital photograph.

**YOY and Juvenile**--Preserve 2 to 10 specimens from each gear type at each station.

**Group III** - Small to moderate-sized fish, adults (and some juvenile and YOY) easy to identify.

**Adults**--Preserve 2 to 5 specimens per lake.

**Juvenile**--Preserve 2 to 5 specimens per lake.

**YOY**--Preserve 2 to 5 specimens from each gear type at each station.

**Group IV** - Small or difficult to identify or likely to hybridize.

**Adults**--Preserve 2 to 10 or more specimens per gear at each station if <150 mm; otherwise preserve 1 specimen per gear type at each station. When in doubt, preserve additional specimens.

**YOY and Juvenile**--Preserve 5 to 30 or more specimens per gear type at each station; preserve more (possibly all) if species identity is unclear.

## **8. Data and Records Management**

1. All data and information pertaining to sample collection is to be recorded according to the Recording of Field Data and Sampling Information Standard Operating Procedure.
2. Any known issues that may compromise the data shall be recorded in field notebooks, field data sheets (including electronic field data sheets), and chain of custody forms.
3. The chain of custody form is relinquished to the receiving laboratory. A copy is kept with the sampling records at the USEPA New England Regional Laboratory, 11 Technology Dr., North Chelmsford, MA 01863 for at least three years.

## **9. Quality Control and Quality Assurance**

- Information pertaining to data representativeness, comparability, completeness, validation and usability can be found in the project-specific quality assurance project plan (QAPP).
- All field QC sample requirements in the QAPP must be followed. These may involve trip blanks, equipment blanks, field duplicates, and the collection of extra samples or sample volumes for laboratory quality control.
- Data that is incomplete, of poor quality, and/or conflicting shall be dealt with in the manner specified in the project-specific QAPP.

## **10. Waste Management and Pollution Prevention**

1. During field sampling and analysis events, hazardous waste may be produced from the collection of samples. The waste must be handled and disposed of in accordance with federal, state, and municipal regulations. Dispose of the hazardous waste produced at the site, if the operating site has proper disposal available. If there is no disposal that meets regulatory requirements, the waste must be transported back to EPA-NE and transferred to the hazardous waste manager. Sample volumes should be minimized to reduce unnecessary waste.

## **11. Preventative Maintenance**

1. All preventative maintenance of the electroshock boat is the responsibility of the boat operator (see Table 1).
2. After sampling all sampling nets must be cleaned with soap and water in order to remove all materials that are still attached to the net, prior to the next sampling event.



(Note if the nets are not going to be used for an extended period of time they should be allowed to fully dry in order to minimize the build up of mold.)

3. Also, all other sampling equipment (boats, boat motors, trailers, vehicles) need to be cleaned and checked to insure that no exotic species are transported between lakes.

## 12. References

Baker, John R., David V. Peck, and Donna W. Sutton (editors). 1997. Environmental Monitoring and Assessment Program Surface Waters: Field Operations Manual for Lakes. EPA/620/R-97/001. U.S. Environmental Protection Agency, Washington, D.C.

Smith-Root Owners Operation and Maintenance Manual, 1999. (<http://www.smith-root.com>)

U.S. Fish and Wildlife, Electrofishing, Ch. 13.

**Table 1:Field Equipment Maintenance, Testing and Inspection Table**

<u>Sampling Equipment/Instrument</u>	<u>Testing/Inspection Activity</u>	<u>Frequency</u>	<u>Acceptance Criteria</u>	<u>Corrective Action</u>
Shock boat engine	Check engine oil	Prior to each sampling event	At full level	Fill
Shock boat engine	Check cooling water discharge	Continuously during operation	Cooling water is discharging	clear debris/replace or fix pump
Shock boat engine	Check Fuel Level	Prior to leaving on survey	Enough fuel for survey and return trip with 1/3 fuel left in reserve	Fill tanks
Shock boat	Check bilge pump	prior to survey and intermittently during survey operation	Pump works	Fix or replace pump
Shock boat	Check freshwater intake pump	Before leaving landing area or dock, upon start up of generator, when filling live wells, and continuously while operating shock boat	Pump in good working order	Fix or replace pump
Shock boat	Check Holding Well Recirculating Pump	Prior to departure from dock/landing area	Pump in good working order	Fix or replace pump
Shock boat	Check Thru-Hull	Before off loading boat and upon return	No visible damage or clogged debris on intake	clean out, repair as necessary
Shock boat	Check Sea Strainer	Continuously During Operation	Strainer Free and Clear of Debris	Clean out, repair as needed
Shock boat	Navigation Lights	Prior to Leaving on Survey	Working	Replace bulb, repair wiring
Shock boat	Deck Lights	Prior to Leaving on Survey	Working	Replace bulb, repair wiring
Shock boat	Holding Tank Lights	Prior to Leaving on Survey	Working	Replace bulb, repair wiring
Shock boat	Holding Tank Flood Lights	Prior to Leaving on Survey	Working	Replace bulb, repair wiring
Shock boat	Work-Up Lights	Prior to Leaving on Survey	Working	Replace bulb, repair wiring
Shock boat	Work-Up Flood Lights	Prior to Leaving on Survey	Working	Replace bulb, repair wiring
Shock boat trailer	Trailer lights	All Lights & Signals are Working	Working	Replace bulb, repair wiring
Shock boat trailer	Wheel bearings & rollers lubricated	Twice per Season	Completed	Grease bearings
Shock boat trailer	Winch	Prior to leaving on survey	Good working condition	Fix or replace
Shock boat trailer	Winch drawn tight to boat	Prior to leaving on survey	Boat drawn tight against roller block	Winch tight
Shock boat	Breakaway chain	Prior to leaving on	Chain hooked on	Hook up chain

**Table 1:Field Equipment Maintenance, Testing and Inspection Table**

<u>Sampling Equipment/Instrument</u>	<u>Testing/Inspection Activity</u>	<u>Frequency</u>	<u>Acceptance Criteria</u>	<u>Corrective Action</u>
trailer	hooked on boat	survey	boat	
Shock boat trailer	Belly strap hooked on trailer and over boat	Prior to leaving on survey	Belly strap securely holding boat on trailer	Cinch down belly strap
Shock boat trailer	Trailer secured to ball hitch	Prior to leaving on survey	Trailer is secure	Secure
Shock boat trailer	Spare trailer tire properly inflated, key for lock, lug wrench and jack all on hand	Prior to leaving on survey	All on hand for survey operation	Repair/find
Shock boat generator	Check oil level	Prior to operation	Oil level full	Fill
Shock boat generator	Cooling water discharge	Continuously during operation	Water is discharging	Check intake/pump, fix or replace